

REPORT DOCUMENTATION PAGE

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MEMORANDUM FOR PRS (In-House/Contractor Publication)

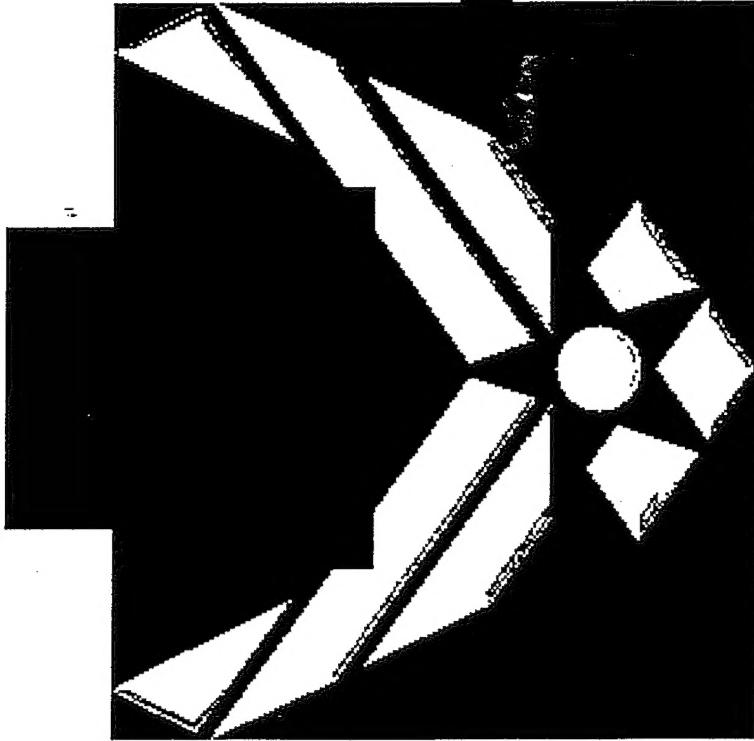
FROM: PROJ(STINFO)

08 Mar 2001

SUBJECT: Authorization for Release of Technical Information, Control Number: AFRL-PR-ED-TP-2001-048
Liu, C.T., "Investigating Near Tip Damage and Crack Growth Behavior in a Solid Propellant"
(VuGraphs)

JANNAF 34th Structures & Mechanical Behavior Subcommittee Meeting (Statement A)
(Cocoa Beach, FL, 26-30 Mar 2001) (Deadline: 09 Mar 2001)

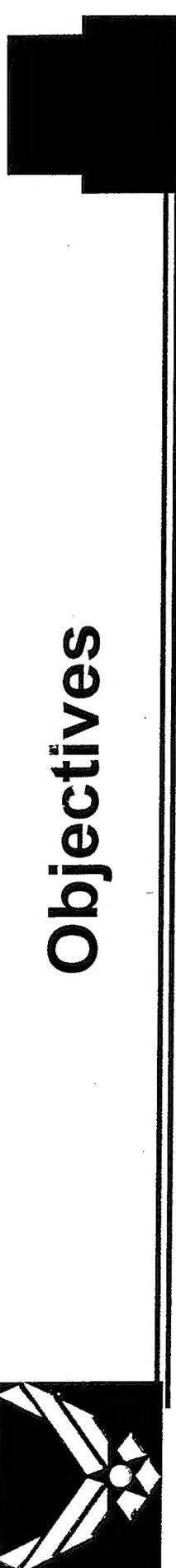
Investigating Near Tip Damage and Crack Growth Behavior in a Solid Propellant



Dr. C. T. Liu

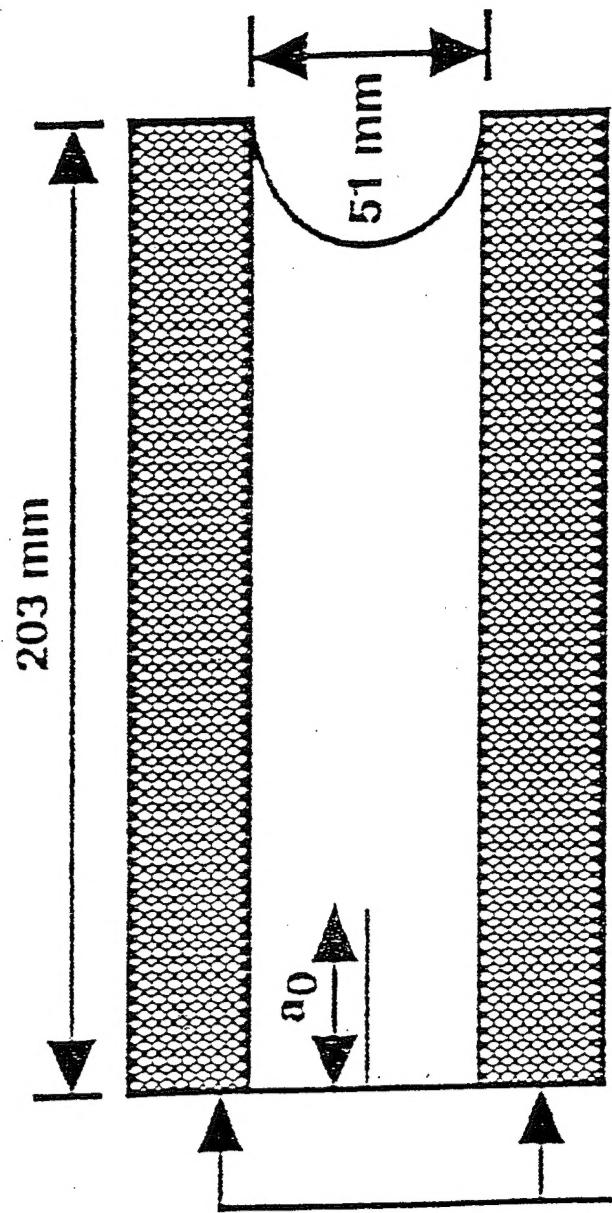
**Principal Materials Research
Engineer**

**Air Force Research
Laboratory**



Objectives

- Investigate the Local Damage Mechanisms Near the Crack tip in a Solid Propellant.
- Investigate the Effects of Local Damage on the Crack Growth Behavior under a Constant Strain Rate Condition.

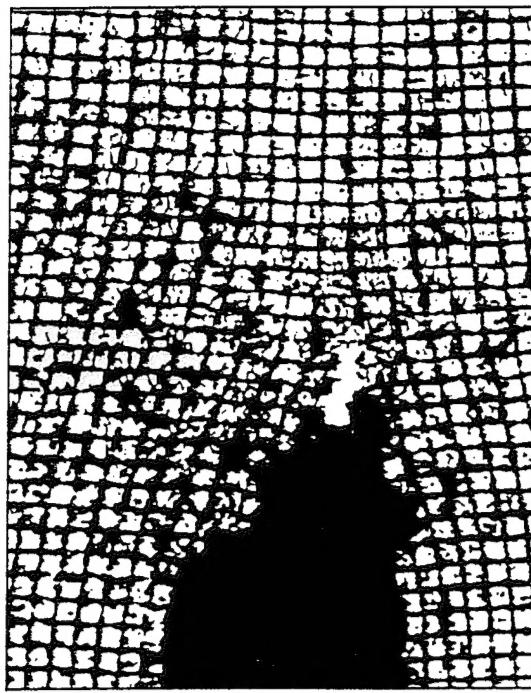
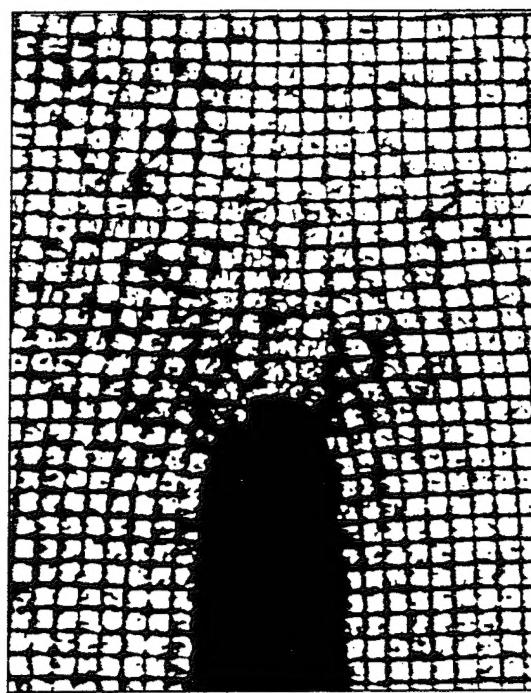
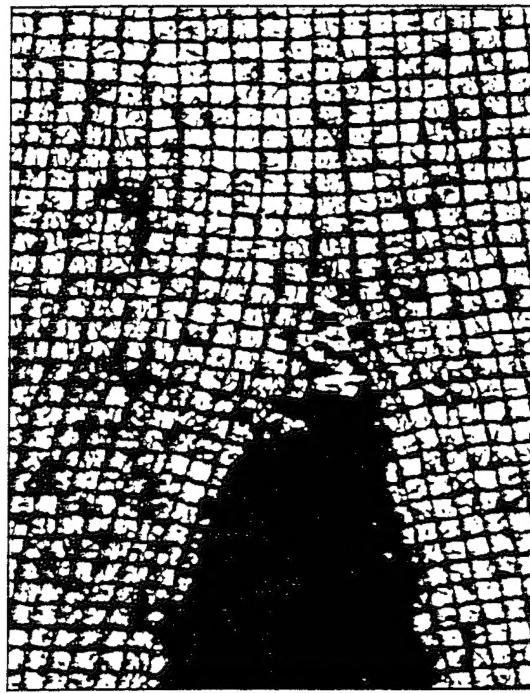
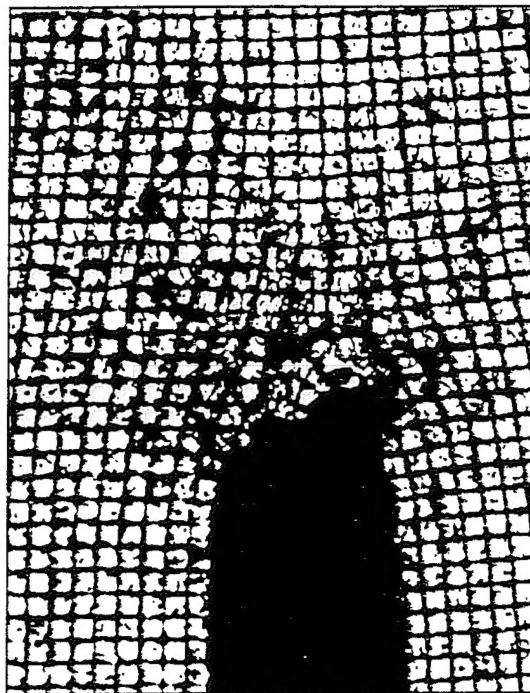


Aluminum grips cemented to specimen
Specimen thickness: 2.5 mm
 $a_0 = 23\text{mm}$

Specimen Geometry

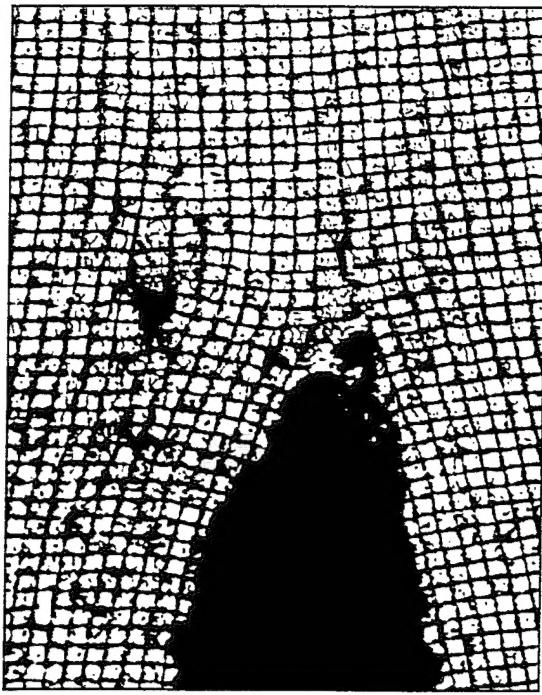
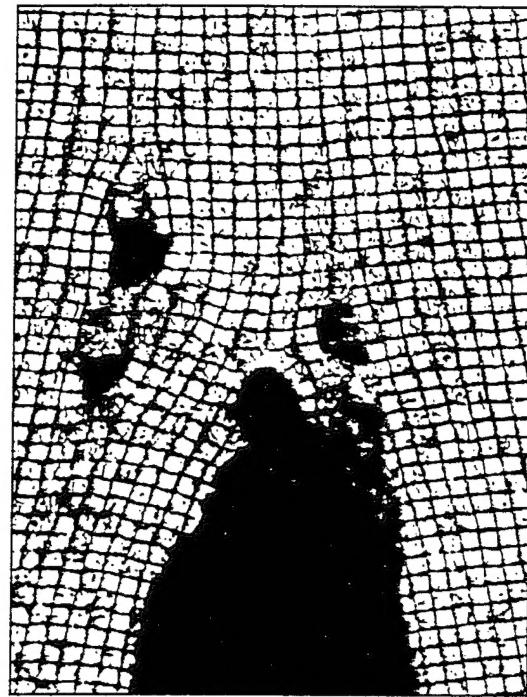


Crack Tip Profiles

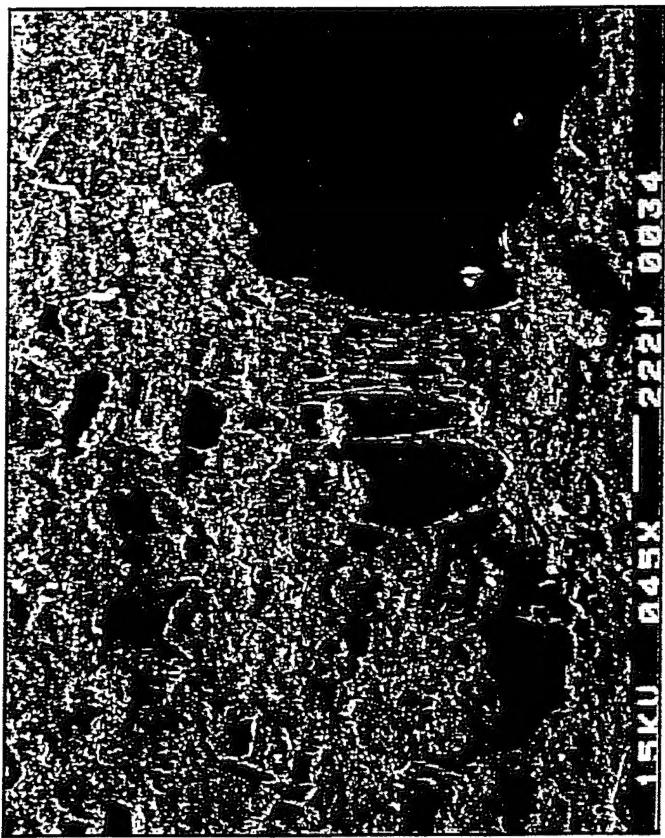
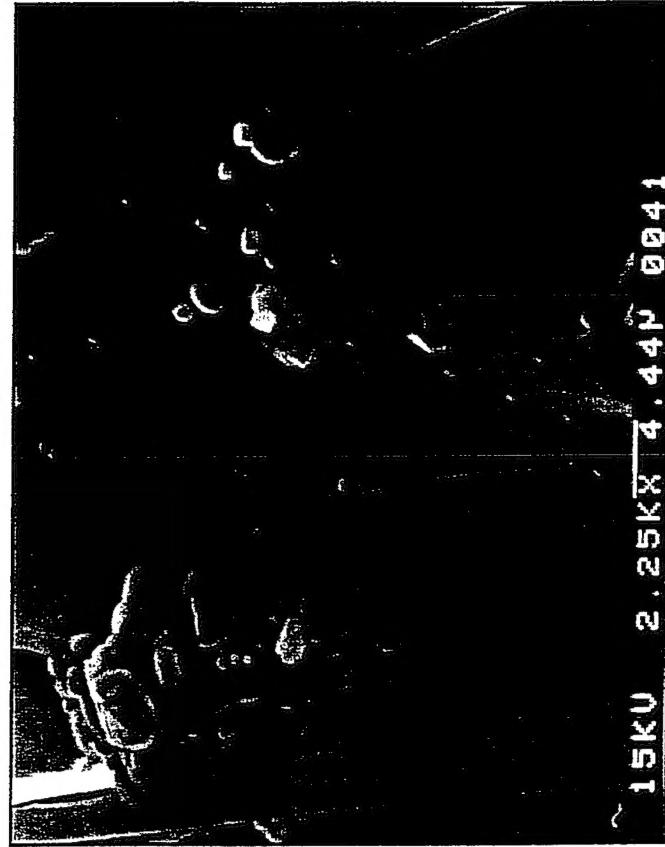


Crack Tip Profiles

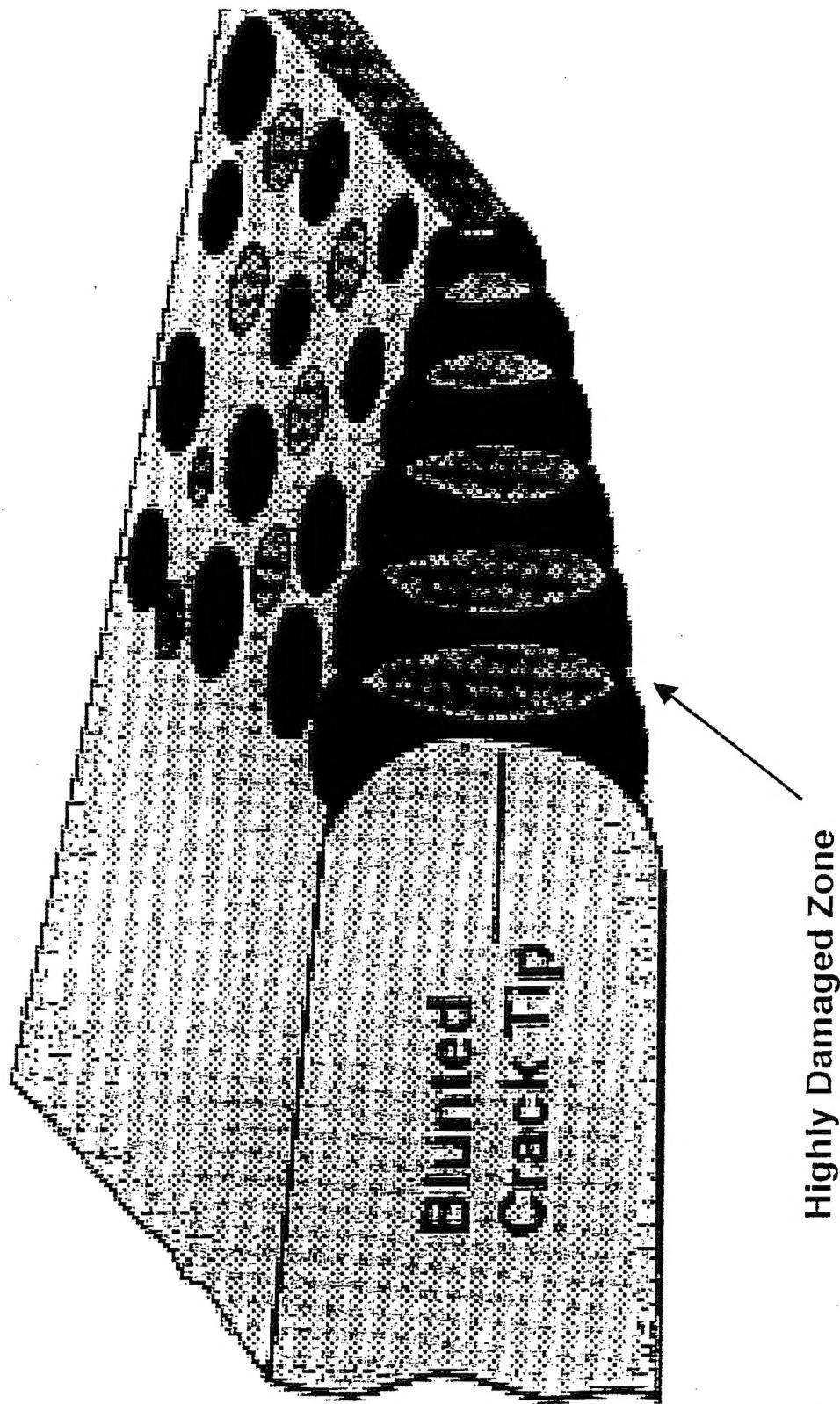
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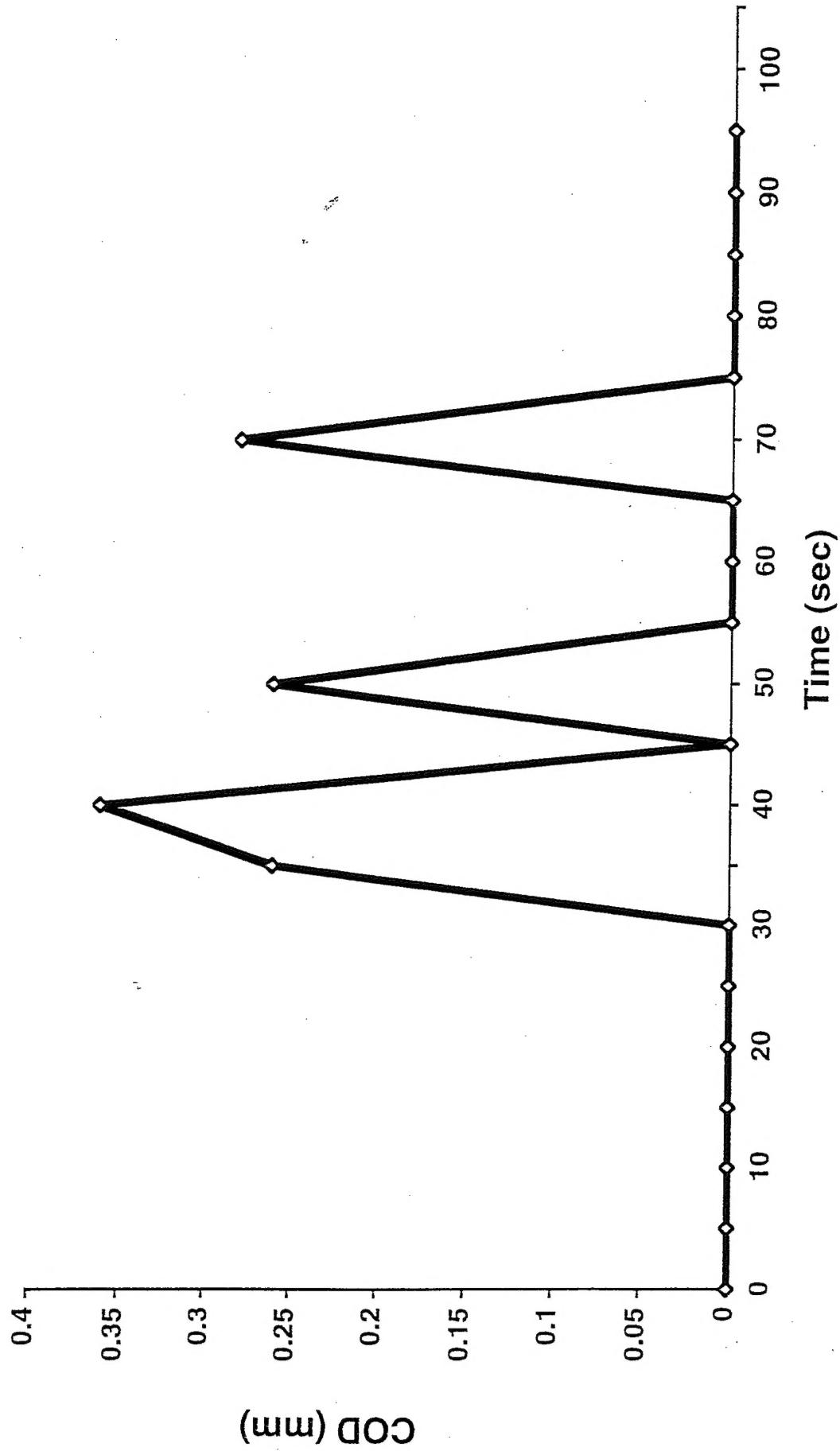
Damage Zone at Crack Tip



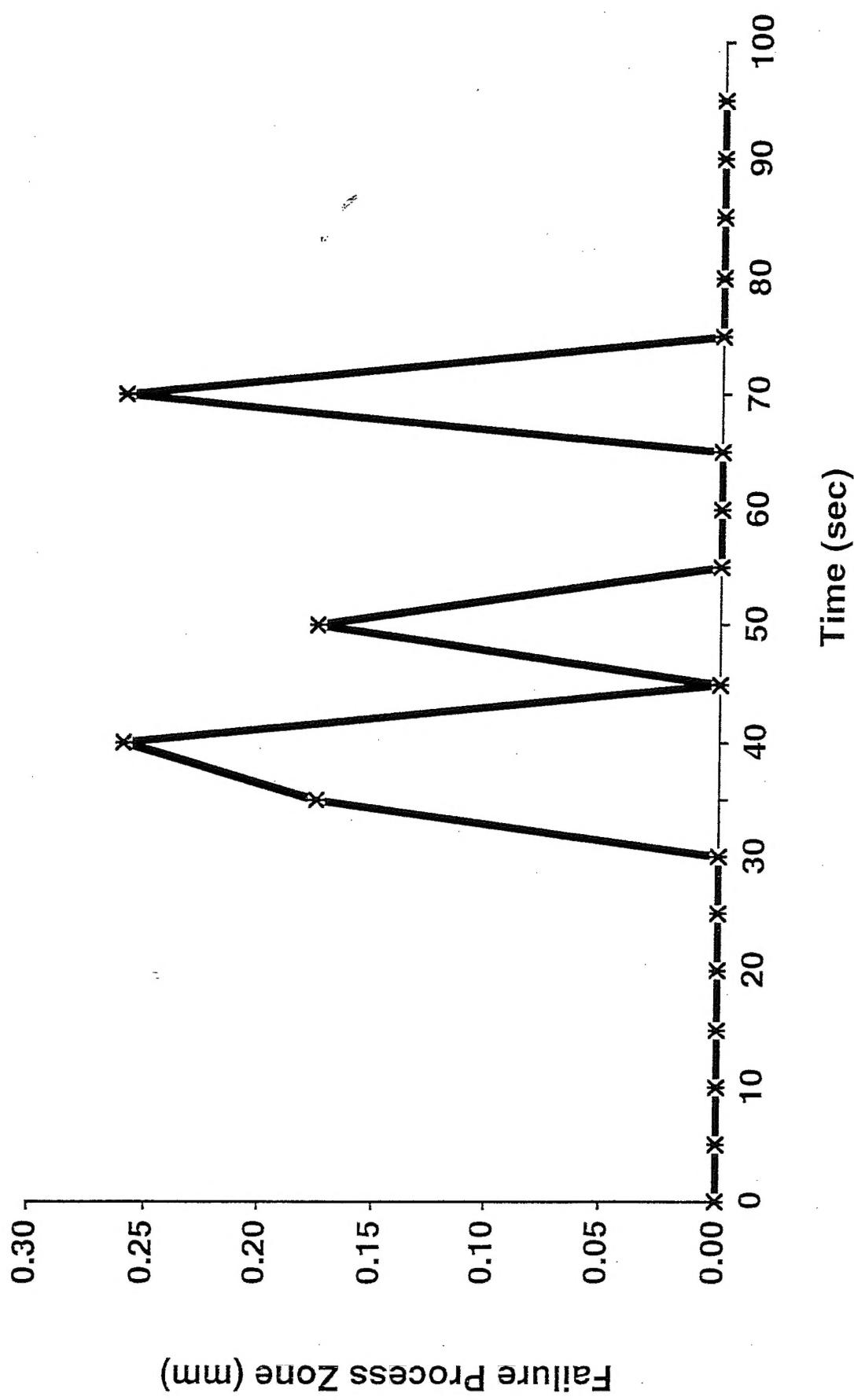
Crack Tip Damage Model



TKLRLT - COD vs. Time



TKRLT - Failure Process Zone vs. Time



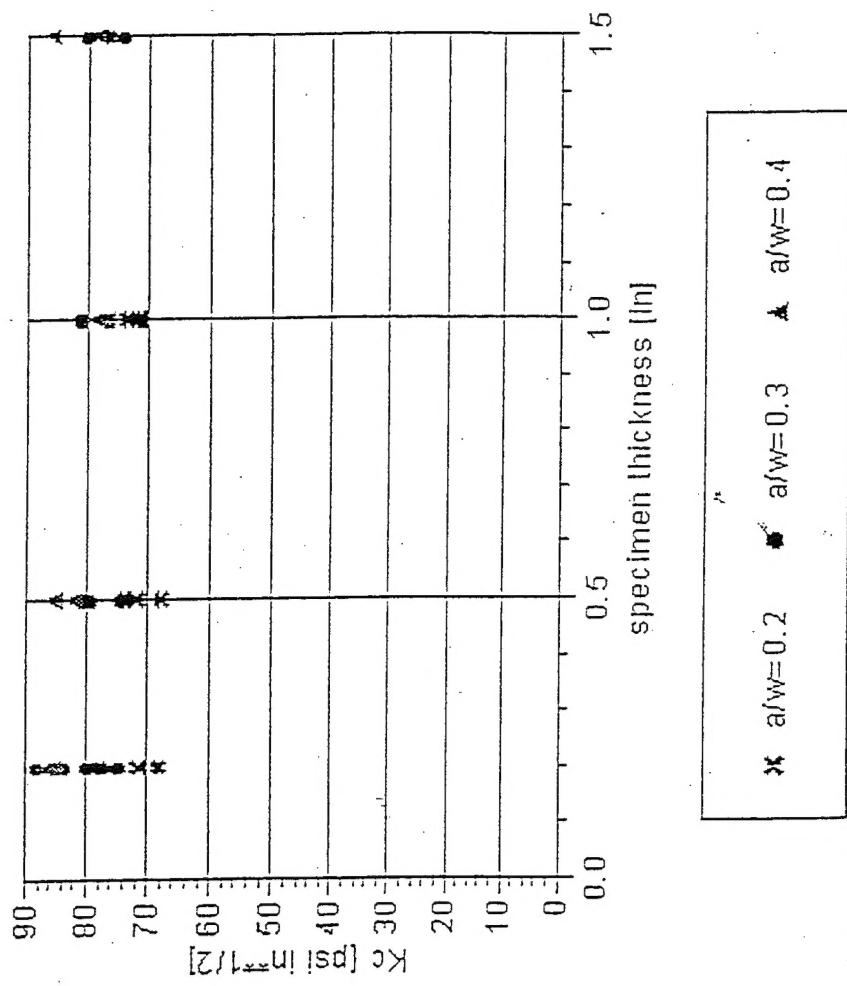


Figure Critical stress intensity factor versus specimen thickness.

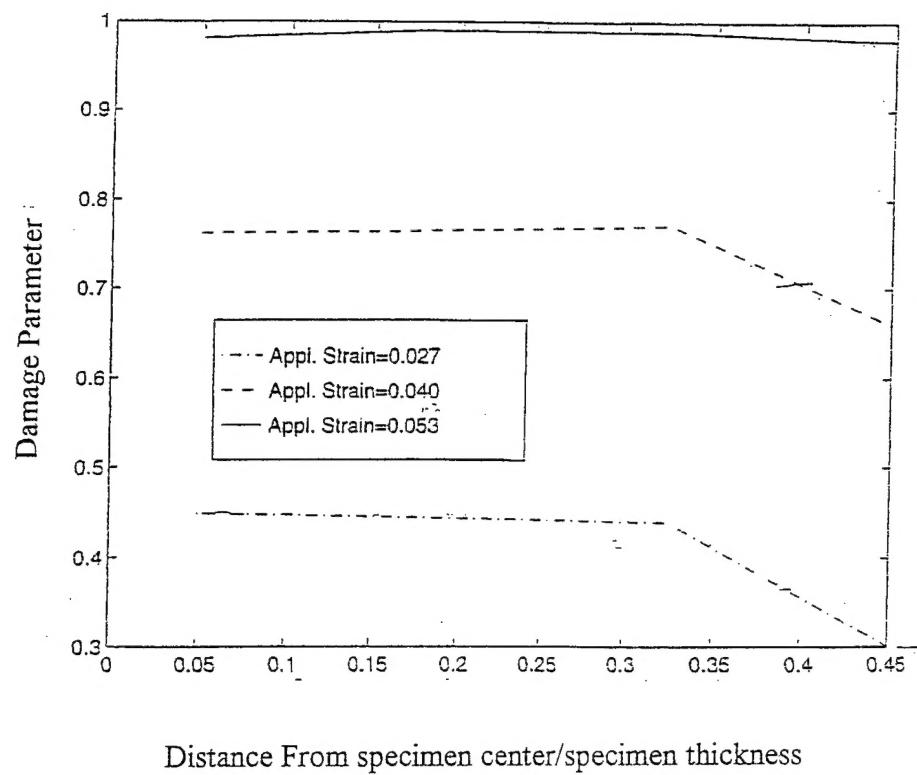


Figure Damage variation along the thickness of the specimen as a function of the applied strain.

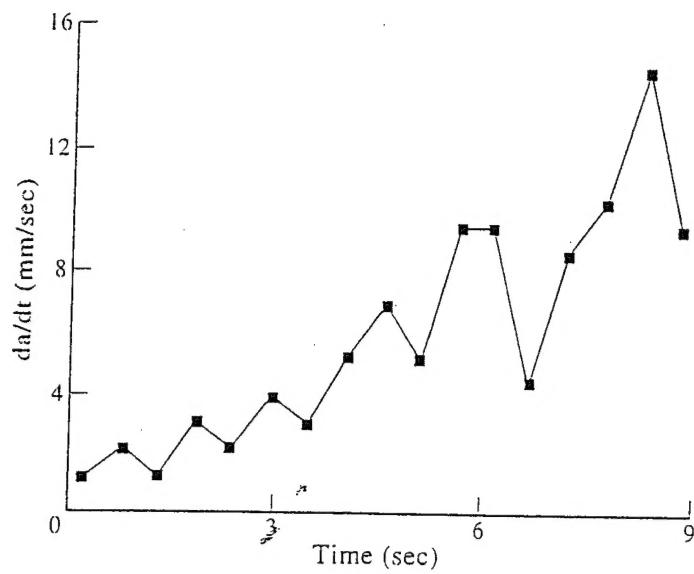


Figure Crack growth rate versus time.

Conclusions

- Experimental findings reveal that severe damage develops at the crack tip.
- The fracture toughness for the onset of crack growth is insensitive to the variation of the thickness of the specimen.
- Three-dimensional micro-macro damage analyses reveal that damage distribution is uniform along the crack front, resulting in a straight crack front.
- The crack-damage interaction is a contributing factor to the fluctuation of the crack growth behavior.